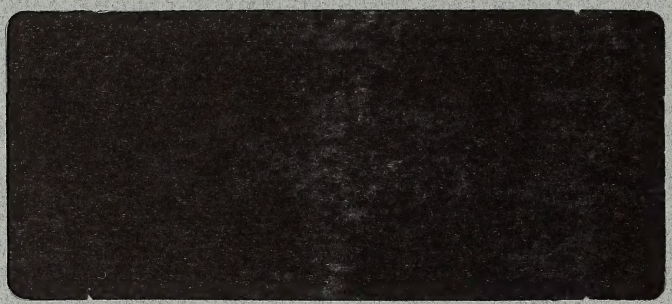
Forest Development Research

PROGRAM

Manning Diversified Forest Products Research Trust Fund
MDFP 6 /96
Basal Bark Application of Release (TM) Herbicide For Mixedwood Management
1996 Interim Report

Alberta
ENVIRONMENTAL PROTECTION



Manning Diversified Forest Products Research Trust Fund MDFP 6 /96 Basal Bark Application of Release (TM) Herbicide For Mixedwood Management 1996 Interim Report

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- Disclaimer -

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Basal bark application

of

Release® Silvicultural Herbicide

for

mixedwood management.

1996 - Interim Report.

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Introduction

A significant portion of Manning Diversified Forest Products Ltd. quota area occurs in the B.18a (Boreal Mixedwood) forest region (Rowe, 1972). This forest type is characterized by mixed stands of aspen (*Populus tremuloides*), birch (*Betula papyrifera*), balsam poplar (*Populus balsamifera*), white spruce (*Picea glauca*) and balsam fir (*Abies balsamea*). The region is occupied by associations of tree species rather than dominant stands of single species, hence the name mixedwood. "Natural" regeneration of upland stands following fire results in site dominance by aggressive pioneer tree species (aspen and pine), followed (over an extended time span) by white spruce and even later by balsam fir ingress. At maturity this process results in a complex mosaic of species and individual trees both within stands and across the broader landscape.

While harvesting this forest mimics natural disturbance and renewal to some extent, it does not duplicate the natural process of renewal (Johnston, 1995). Aspen is an aggressive invader of recently cutover sites due to its ability to reproduce from root suckers, which are not destroyed by logging as they are by wildfire. Forest managers rely on site preparation and planting conifer seedlings to hasten white spruce establishment, and hence, the entire renewal process. Tending treatments to limit aspen growth and density are frequently prescribed following white spruce establishment. Tending does not eradicate aspen from the developing stand; it sets out to better mimic the balance between aspen and white spruce which occurs in "natural" regeneration processes following fire.

Traditional tending methods in Alberta have been motor manual release treatments using brushsaws in younger stands and chain saws in older stands. Tending treatments remove competitive trees and shrubs from the vicinity of established conifer seedlings (or saplings). Motor manual treatments are of limited effectiveness in controlling aspen due to its ability to resprout following cutting. Further, motor manual treatments become difficult and expensive once target species are more than 5 cm in diameter. Alternate tending strategies must be developed for tending older (20 years +) stands.

Manning Diversified Forest Products Ltd. timber quota area contains approximately 8000 ha of reforested cutblocks which *might* benefit from tending. Much of this area is sufficiently old to drastically limit use of motor manual tending. Manning Diversified Forest Products Ltd. assessed tending alternatives based on the following criteria:

1. Effectiveness
2. One pass management of all crop species (conifer and deciduous)
3. Safety
4. Cost
5. Impact on other resources/land uses

This assessment suggested that basal bark application of triclopyr ester herbicide (Release® Silvicultural Herbicide - 480 g/L triclopyr ester) might be a viable tending option. The method is target specific and easily used on trees and shrubs up to 15 cm in basal diameter. An experiment to verify the effectiveness of the herbicide treatment in stand tending - including both brushing (control of selected aspen) and spacing (adjusting white spruce densities) was designed. Rather than focus on tree responses the experiment considered the effect of basal bark treatment with Release® on both tree species and a range of other site values. This paper reports establishment of, and first year data from, that experiment.

Project Objectives

1. Assess the effectiveness and cost of low volume basal bark application of Release Silvicultural herbicide diluted in mineral oil for managing - brushing and spacing - all crop tree species on post juvenile mixedwood sites.

2. Compare the effectiveness and cost of chainsaws and brushsaws for spacing and tending on similar sites.

Prepared by:
Incremental Forest Technologies Ltd.

3. Qualitatively compare the following factors between motor manual and herbicide tending:

a) short term slash loading and fire hazard arising therefrom

b) longer term impacts on forest health - particularly extent of frost damage, windthrow, weevil attack, physical damage.

c) off target impact of Release on crop trees adjacent to treated trees (of the same species.)

d) soil retention of Release herbicide.

e) bird use of treated and untreated areas at 5 intervals annually (spring migration, nesting, fledgling, fall migration and winter.)

The overall objective was to compare motor manual and Release herbicide tending as mixedwood management tools.

Work performed in 1996

Two regenerated cutover areas were identified in the South Hotchkiss oilfield. These areas were cut in 1971 (25 year old stand) and 1981/82 (15 year old stand). Both areas are readily accessible on high grade road and quite uniform in aspen and white spruce size, age and density. Manual tending was prescribed using chain saws on the older stand, brushsaws on the younger stand. Both stands were also treated with Release® diluted in isoparaffinic mineral oil.

Several areas were sampled and laid out in the two stands. Initial treatment areas were used to teach crews stand reconstruction, that is; crop tree selection based on:

1. variable density spacing rules
2. crop tree health, thrift and vigor
3. species priority ranking

Once the crew became skilled in crop tree selection and use of specific treatment techniques they were moved into measured areas where productivity could be monitored. The productivity assessment areas were marked with permanent sample plots to monitor:

1. crop tree response to treatment,
2. slash (and hence fuel) loading,
3. soil dissipation of the herbicide,
4. non-target effects of the herbicide established.

Pretreatment measurements of basal area growth of trees, density, bird use, and tree species composition were made in the sample areas. Following treatment density of aspen and white spruce saplings was re-measured in motor manual treatment areas (assessments in Release plots could not be made due to slow kill of white spruce saplings with this treatment.) Slash loading after treatment was assessed in all treatment areas.

Bird surveys were conducted at the intervals specified.

Results of 1996 work

Productivity and Cost Study

Productivity of stand tending methods are shown in Table 1 and Figure 1. Chain saw tending of the 25 year old stand was slowest with 84 person-hours required to treat one hectare (or a rate of 0.012 ha per hour), this was followed by brushsaw tending of the 15 year old stand with a productivity of 21 person-hours per hectare (0.05 ha/hr). Basal bark treatment of the older stand required 8.2 person-hours per hectare (0.12 ha/hr), whilst the younger stand required only 7.2 person-hours per hectare (0.14 ha/hr).

Both motor manual tending treatments were more costly than herbicide tending, even including the cost of herbicide and oil. Figure 2 and Table 1 show cost comparisons between the various methods. $1512 per hectare for chainsaw tending (25 year old stand) and $348 per hectare for brushsaw (15 year old stand). Basal bark tending of the older stand cost $254 per hectare due to slightly lower productivity and slightly higher herbicide use rate than treatment of the 15 year old stand ($208 per hectare.) From a cost standpoint it appears better to tend early and if that is not possible to use basal bark herbicide not motor manual tending.

Initial Densities and Growth Rates

Average pretreatment densities of both aspen and white spruce are shown in Table 2 and Figures 3 and 4. Taken alone the density data are somewhat misleading -white spruce appear to dominate the older stand at 16,600 stems per hectare. These densities were due to the original reforestation treatment being blade scarification and seeding (followed by some good natural seed crops. This resulted in dense clumps of white spruce seedlings suppressed by competition among themselves and from the adjacent large aspen. Growth was measured as periodic basal area increment - measurement of increases in area of the

brushsaw treatment increased use. These data must be regarded as preliminary until more bird use surveys have been conducted over the next two years.

Herbicide Residues

Soil samples to assess herbicide residues were taken in front of six crop trees and behind six crop trees (relative to the direction of herbicide application); these samples were composited into a single analytic sample. This procedure was repeated twice at each sample timing, in June and October. Samples were analyzed for triclopyr acid with a detection limit of 0.5 PPM. Table 10 reports results of these samplings.

Triclopyr residues were found in both behind tree samples in June and in one behind tree sample in October. The levels of triclopyr found are near the detection limit of the method used so should be considered to indicate presence rather than be used for quantitative comparison.

Discussion and Conclusions

Basal bark tending is clearly more productive and less costly than motor manual tending. Differences in productivity (and cost) are magnified as stand age increases.

Fuel loading and fire hazard were much greater following motor manual tending. This is due to a greater accumulation of fuel and especially an increase in lighter fuels which contribute significantly to rapid fire spread.

Herbicide residues in soil (near the limit of detection) were present on the site 4 to 5 months after treatment.

Given the preliminary nature of many results few inferences can be made as to the effect of tending method on forest health; crop tree growth; vigor and thrift; or other longer term impacts on the site.

Follow up monitoring of forest health, response and soil residues must occur in 1997 and 1998 to address these questions.

Table 1. Productivity, herbicide use, and cost of mixedwood stand tending treatments.

Stand age	Treatment	Productivity (person hours/ha)	Herbicide use (L/ha)	Cost* ($/ha)
25 years	Chainsaw tending	84.0	Not applicable	$1,512.00
	Basal bark herbicide tending	8.2	3.8	$254.00
15 years	Brushsaw tending	21.0	Not applicable	$378.00
	Basal bark herbicide tending	7.2	2.8	$208.00

Footnotes: * based on $18/person hour (all found), $25/L for herbicide, and $1/L for mineral oil

Figure 1. Productivity of stand tending treatment methods.

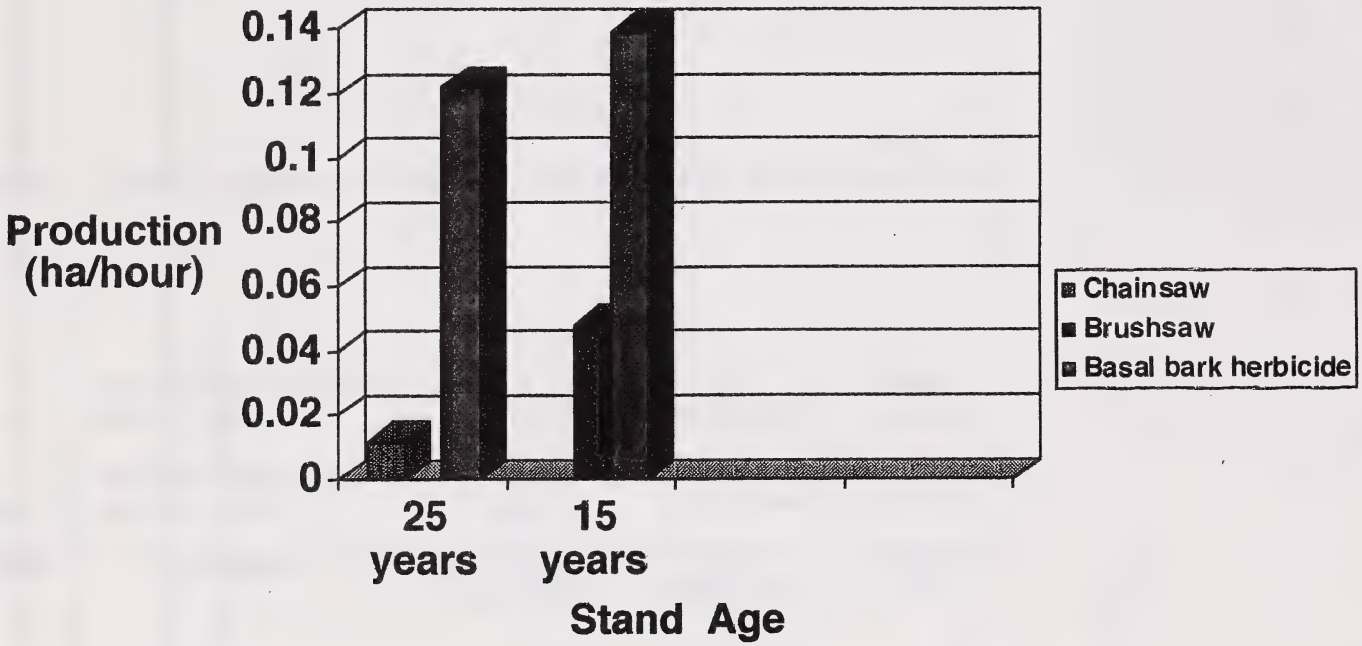


Figure 2. Cost of stand tending treatment methods.

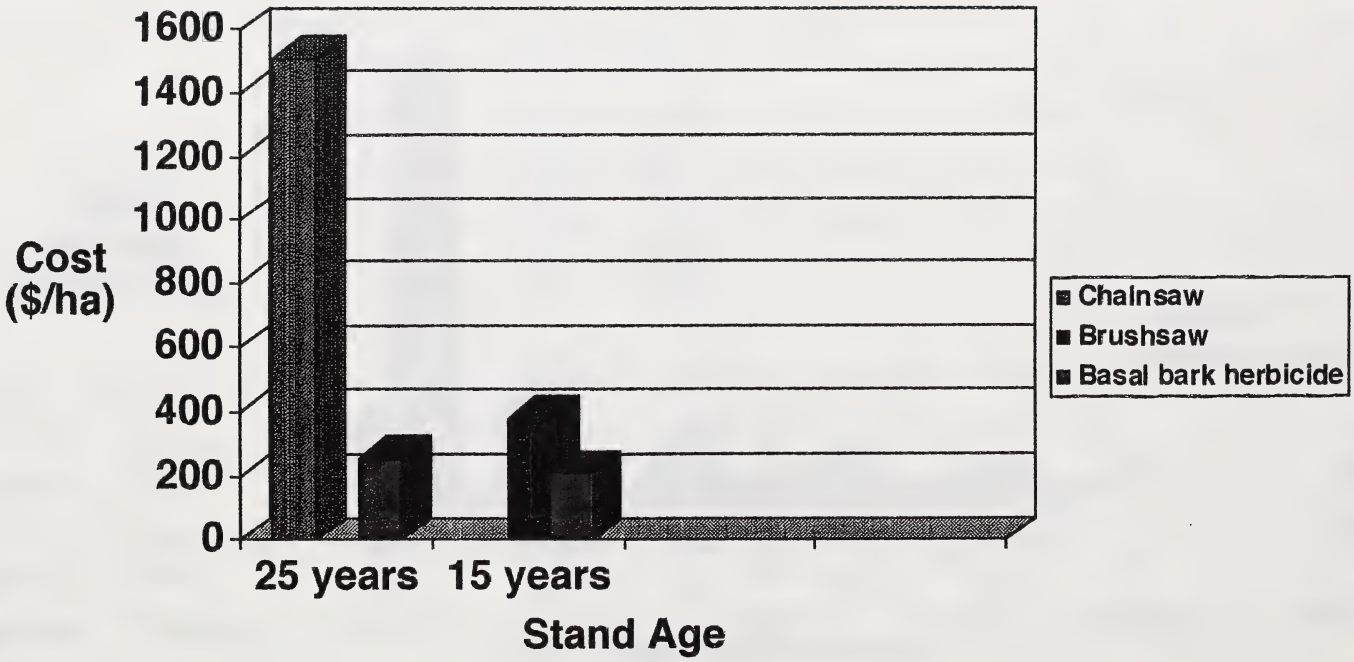


Table 2. Average pretreatment tree densities, all treatment types.

Stand age	Species	Stems/ha (by diameter class) 0-3 cm	3-6 cm	6-9 cm	9-12 cm	12-15 cm	Total
25 years	Aspen	3090	3590	2450	1420	740	11290
	White Spruce	16600	250	25	0	0	16875
15 years	Aspen	2620	2770	2300	770	170	8630
	White Spruce	830	0	0	0	0	830

Figure 3. Average pre-treatment densities, 25 year old stand.

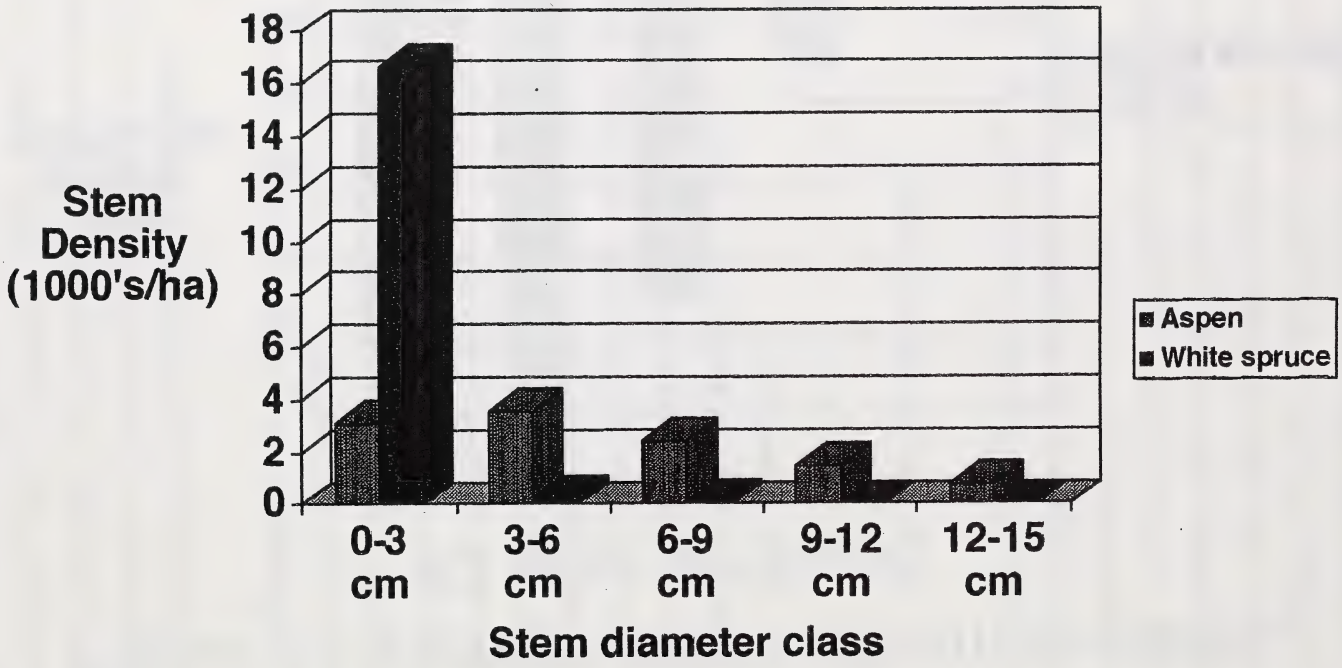
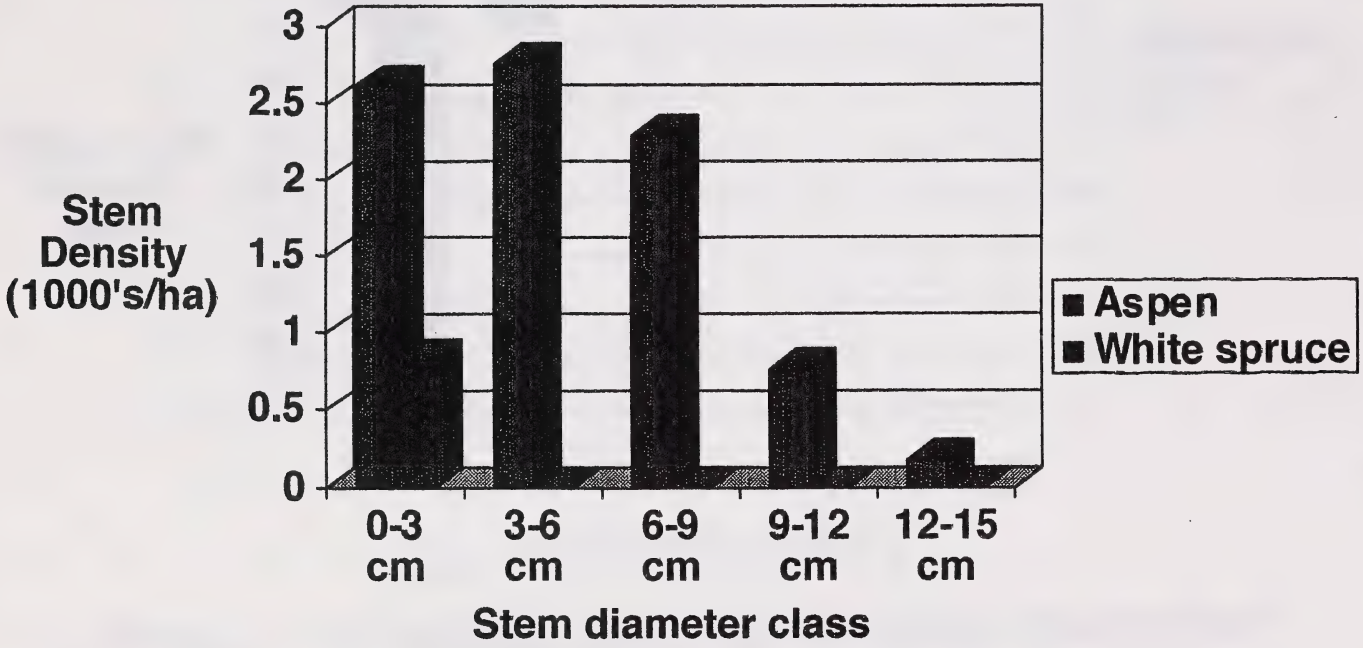


Figure 4. Average pre-treatment densities, 15 year old stand.



base of individual trees in specified (2 year) time intervals. From the growth data (Table 3 and 4, Figures 5 and 6) it is apparent that in both stands white spruce is merely present not growing vigorously. This is very common in regenerated mixedwood cutovers. No growth responses to treatment can be assessed at present, in fact, growth responses are not likely to become apparent until 3 years after treatment.

Aspen densities were higher in the 25 year old stand than in the 15 year old stand. White spruce densities were much higher in the 25 year old stand than in the 15 year old stand. In both cases differences are likely due to differences in establishment practice. The blading treatment used to prepare the older site for seeding likely stimulated aspen suckering causing high initial aspen densities. Direct application of seed, followed by good seed years resulted in an overabundance of white spruce seedlings in the older stand. The younger stand was site prepared using a spot scarifier (Bräcke) which did not stimulate aspen suckering as dramatically. Also, white spruce seedlings were planted on the site giving better density control. The spot scarifier was less likely to result in reproduction from natural seedfall further contributing to more evenly spaced and less dense white spruce seedlings.

Changes in Density Following Treatment

Due to the subtlety of Release® symptoms on white spruce saplings changes in density following treatment can only be reported for motor manual treatment. (Changes in density in Release® treated plots will be reported in the 1997 report.) These data are shown in Table 5 and Figures 7 and 8. Aspen in the older stand had begun to express dominance among themselves, thus larger aspen were thriftier, healthier trees and were selected as crop trees; with smaller, less vigorous trees being removed to reduce competition to aspen or white spruce "crop trees". In the younger stand dominance was less clearly expressed so tending removed a more uniform distribution of aspen sapling sizes.

Table 3. Periodic basal area increment, y species, 25 year old stand.

Stand age (years)	Basal area increment (mm2) White spruce	Aspen
0-2	12	105
2-4	12	125
4-6	12	127
6-8	16	119
8-10	22	122
10-12	Not available	141
12-14	42	114
14-16		126
16-18		110
18-20		Insufficient data
20-22		Insufficient data

Figure 5. Periodic basal area increment, 25 year old stand

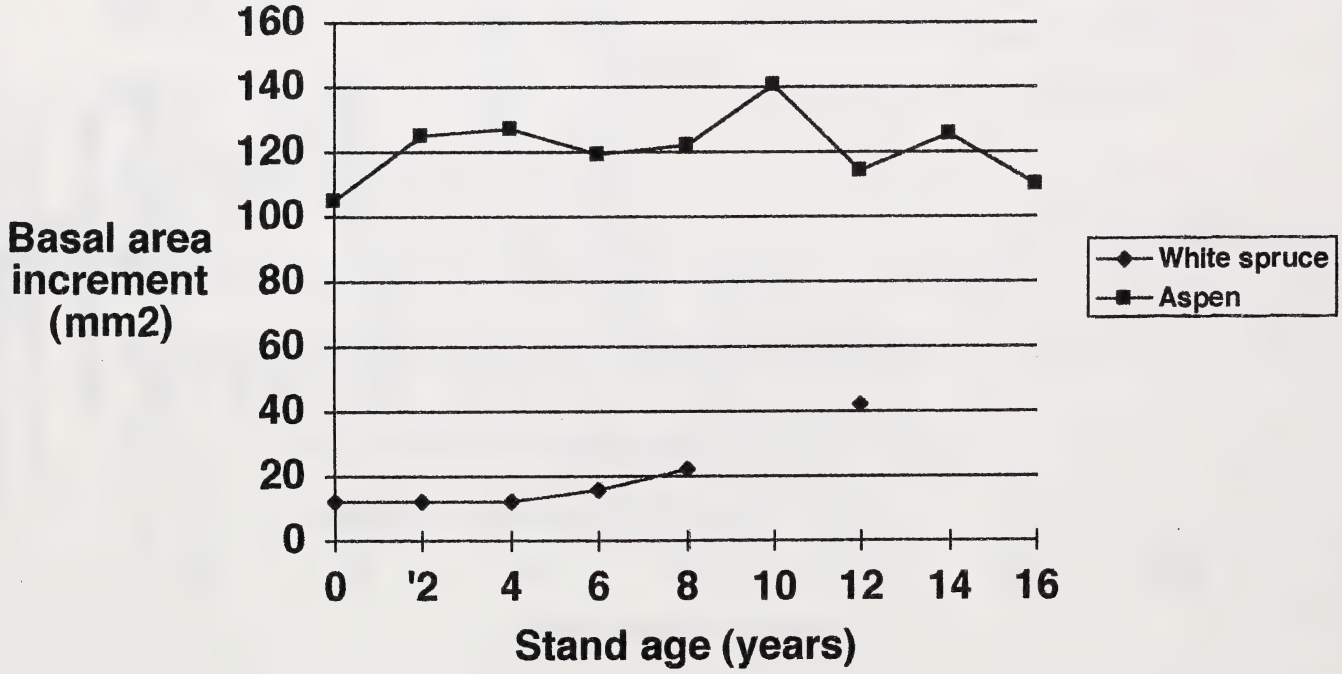


Table 4. Periodic basal area increment, y species, 15 year old stand.

Stand age (years)	Basal area increment (mm2) White spruce	Aspen
0-2	4	59
2-4	4	105
4-6	3	118
6-8	4	107
8-10	5	118
10-12	Insufficient data	113
12-14		116

Figure 6. Periodic basal area increment, 15 year old stand.

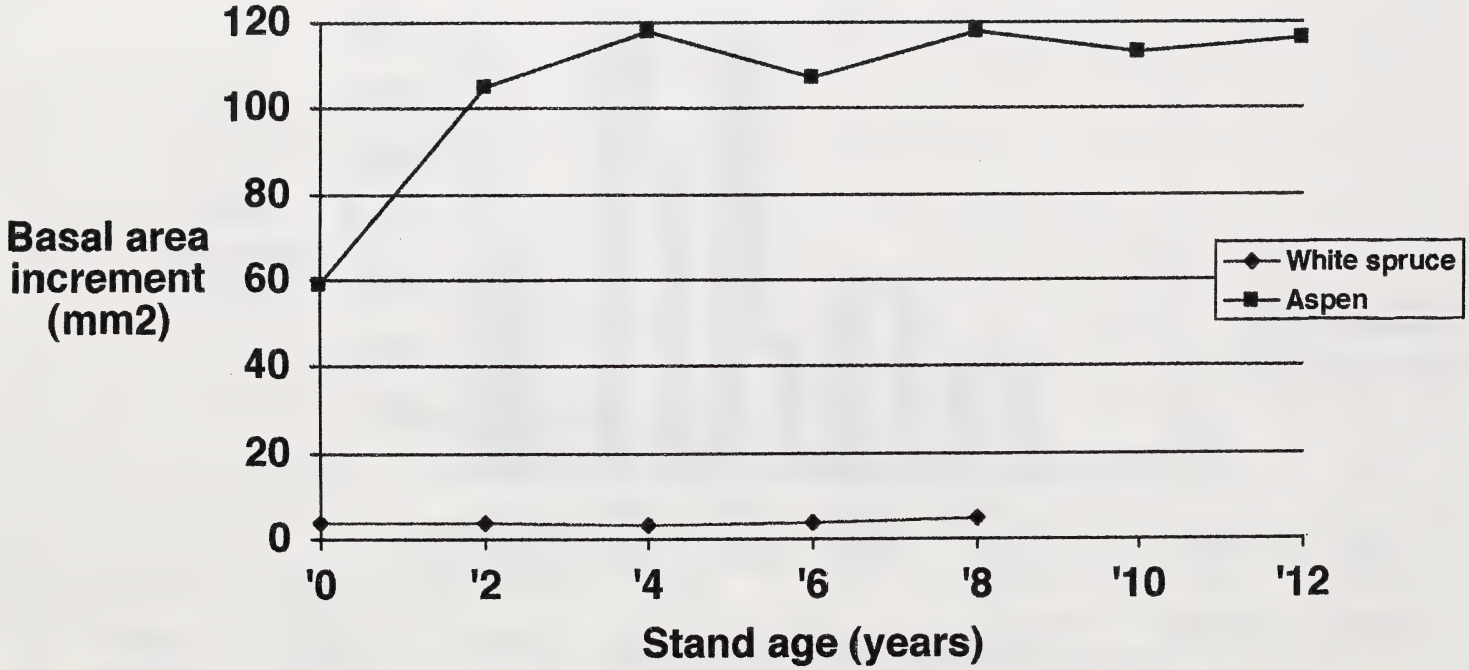


Table 5. Changes in aspen density following motor manual stand tending treatments.

Stand age (years)	Treatment method	Assessment timing	Stems/ha (by diameter class) 0-3 cm	3-6 cm	6-9 cm	9-12 cm	12-15 cm	Total
25 years	Chainsaw	Pre-treatment	1600	3400	3400	1400	800	10600
		Post-treatment	0	2400	1000	1400	800	5600
		Change in density	1600	1000	2400	0	0	5000
15 years	Brushsaw	Pre-treatment	4600	2200	2000	1400	200	10400
		Post-treatment	2000	1600	1000	800	0	5400
		Change in density	2600	600	1000	600	200	5000

Figure 7. Changes in density following chainsaw treatment, 25 year old stand.

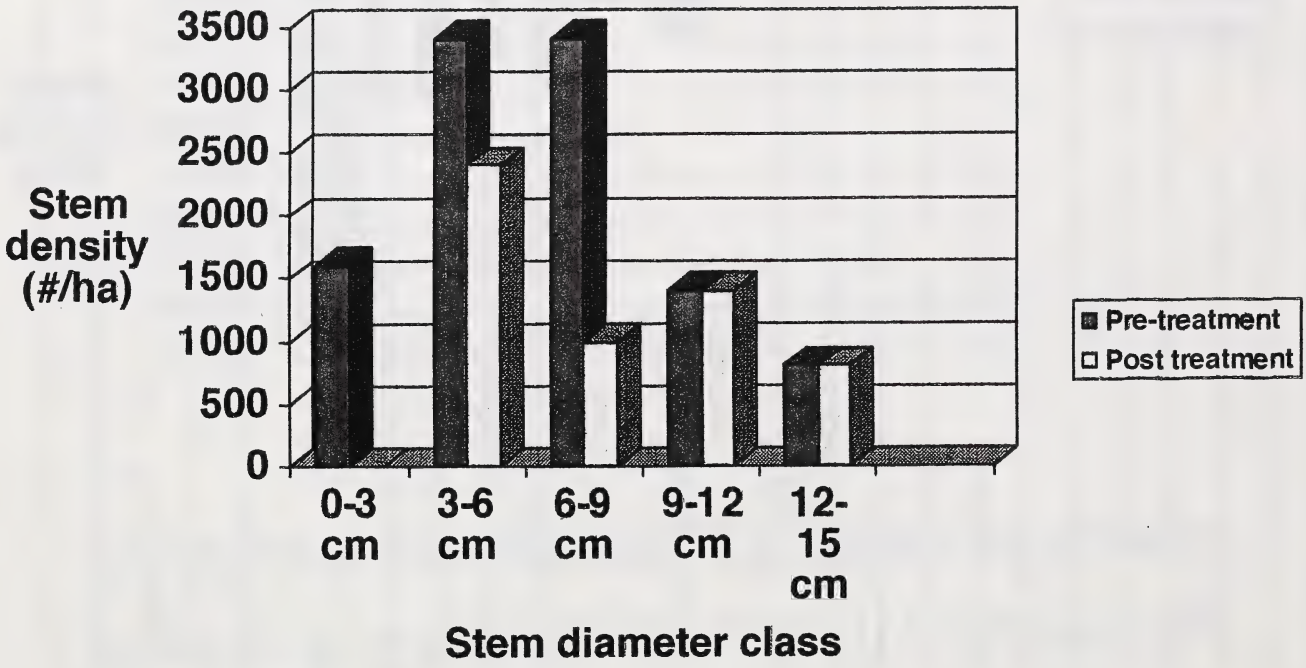
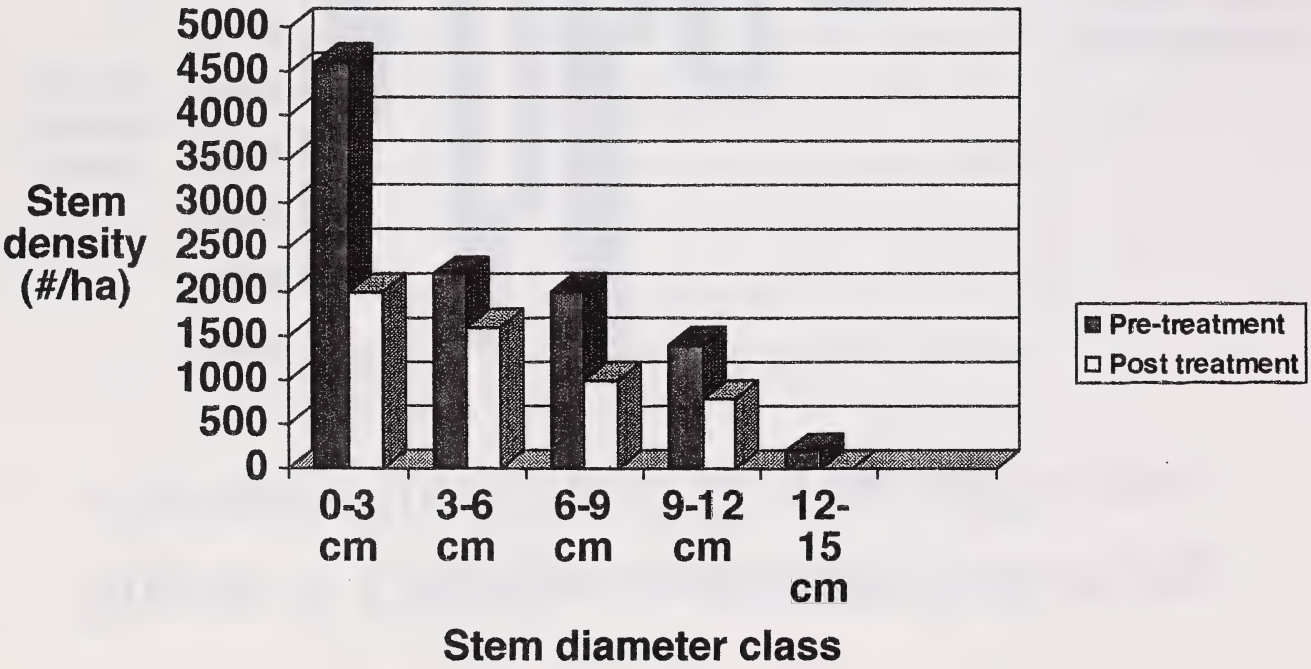


Figure 8. Changes in density following brushsaw treatment, 15 year old stand.



Slash Loading

The Alberta Land and Forest Service slash intercept assessment of fuel loading was run on both basal bark herbicide and motor manual treated areas. Results are shown in Table 6 and Figures 9 and 10. Slash loading was much higher following motor manual treatment than following basal bark herbicide treatment - in both stands. This was especially true for pieces larger than 3 cm in diameter and in the older stand (Figure 10.)

In the 25 year old stand slash loading in the smaller diameter classes was three-fold higher in the chainsaw treated area than in the herbicide treated area. Larger diameter slash was only present following motor manual treatment. In the 15 year old stand there was a 50 percent more of the smallest (<1 cm) slash and 12 times more 1 to 3 cm diameter slash. Again larger slash was only present after motor manual tending.

Bird Use Surveys

Bird use surveys of the area surrounding the project and specific treatment sites were made in May, June, August and October. Surveys employed a line transect and tallied both species and number of individuals (by species.) Tallies were based on both visual identification and by song identification. Data gathered are shown in Tables 7 and 8 (a through c) and Figure 11. An attempt was made to identify differences in use due to stand tending regime by calculating Simpson's diversity index for bird use of each treated area (Table 9 and Figure 12.) Simpson's diversity index integrates number of species, abundance of individuals and frequency of use to measure overall diversity in a population. The larger a Simpson's Index number the more diversity of use. As can be seen from the data initial response to tending was quite variable. In the older stand both treatments resulted in increases in use, with more use of the chainsaw treated area than of the basal bark treated area. In the younger stand basal bark treatment resulted in reduced use, while

Table 6. Slash loading following stand tending treatments.

Stand age (years)	Treatment method	Number of slash pieces found per transect				
		<1 cm	1-3 cm	3-5 cm	5-7 cm	>7 cm
25 years	Chainsaw	331	47	10	6	4
	Basal bark	113	9	0	0	0
	Difference*	+218	+38	+10	+6	+4
15 years	Chainsaw	140	13	10	4	1
	Basal bark	99	1	0	0	0
	Difference*	+41	+12	+10	+4	+1

Footnotes: * "+" in front of a number indicates more slash pieces found in motor manual treatment.

Figure 9. Post treatment slash loading, 25 year old stand.

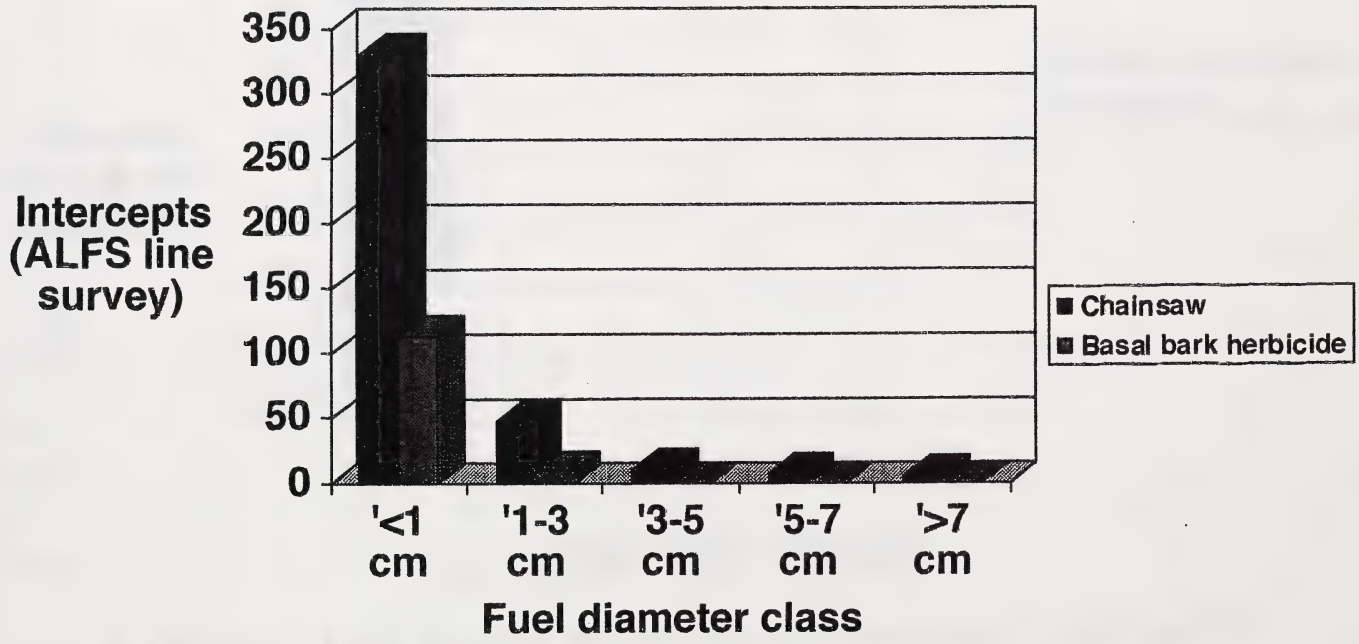


Figure 10. Post treatment slash loading, 15 year old stand.

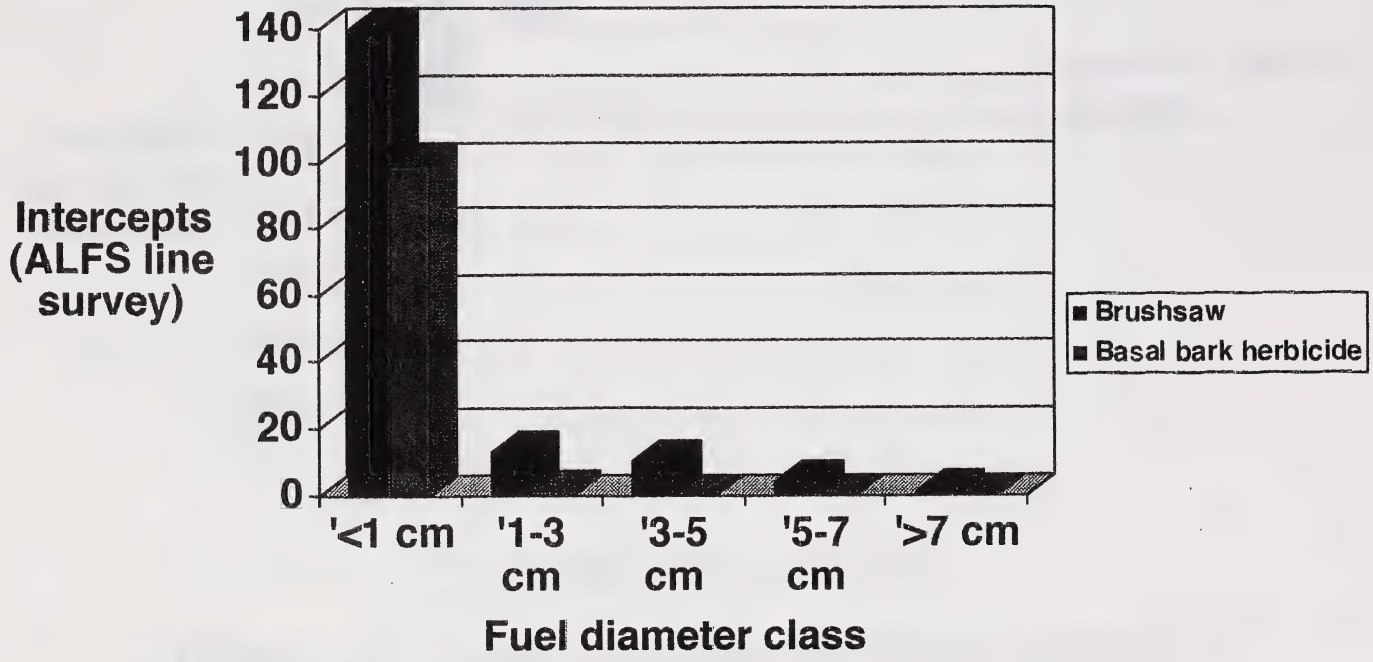


Table 7. Total observations and ranking, May thru October, 1996.

Species	May 2		June 18 - 19		August 3 - 4		October 1 -2		Total	
	Observed	# Birds	Observed	# Birds	Observations	# Birds	Observations	# Birds	Observations	# Birds
Gray jay	4	4	7	12	7	10	8	14	26	40
Raven	2	4	3	3	2	3	9	12	17	22
Ruffed grouse	4	6	4	4	5	5	3	2	16	18
S. colored junco	1	5	1	1	3	26	5	82	10	114
Robin	2	2	3	3	3	3	1	1	9	9
W. throated sparrow	0	0	2	2	6	7	0	0	8	9
Least flycatcher	0	0	2	2	4	4	0	0	6	6
Hairy woodpecker	0	0	0	0	0	0	0	0	5	5
B-capped chickadee	0	0	0	0	1	1	0	0	5	18
Downy woodpecker	0	0	1	1	1	1	3	3	3	3
Vesper sparrow	0	0	2	2	1	2	4	17	3	4
Northern flicker	0	0	1	1	2	2	1	1	3	3
Savannah sparrow	0	0	2	4	0	0	0	0	2	4
American kestrel	0	0	1	1	1	1	0	0	2	2
Tennessee warbler	0	0	1	1	1	1	0	0	2	2
Swamp sparrow	0	0	2	2	0	0	0	0	2	2
Spruce grouse	0	0	0	0	1	1	1	1	2	2
R. tail hawk	0	0	1	1	0	0	1	1	2	2
Merlin	1	1	0	0	0	0	0	0	1	1
Boreal chickadee	1	4	0	0	0	0	0	0	1	4
Marsh hawk	1	1	0	0	0	0	0	0	1	1
R-winged blackbird	0	0	1	1	0	0	0	0	1	1
Cedar waxwing	0	0	0	0	1	1	0	0	1	1
American redstart	0	0	1	1	0	0	0	0	1	1
R-breasted nuthatch	0	0	0	0	1	1	0	0	1	1
Trail's flycatcher	0	0	1	1	0	0	0	0	1	1
Horned lark	1	20	0	0	0	0	0	0	1	20
Canada goose	1	2	0	0	0	0	0	0	1	2
Snow bunting	1	15	0	0	0	0	0	0	1	15
Mallard	1	2	0	0	0	0	0	0	1	2
Green winged teal	0	0	1	2	0	0	0	0	1	2
Lesser yellowlegs	0	0	0	0	1	2	0	0	1	2
Great gray owl	0	0	0	0	0	0	0	0	1	1
Magpie	0	0	1	2	0	0	0	0	1	2
Magnolia warbler	0	0	1	1	0	0	0	0	1	1

Table 8a. Bird observations in overall research area.

Species	*Total area*		*N - S transect*		*E - W transect*	
	Observations	# Birds	Observations	# Birds	Observations	# Birds
Gray jay	23	33	12	19	2	2
Raven	17	22	6	7	2	2
Ruffed grouse	16	18	5	5	4	4
S. colored junco	10	114	6	89	1	5
Robin	9	9	2	2	1	2
W. throated sparrow	8	9	2	3	2	2
Least flycatcher	6	6	1	1	1	1
Hairy woodpecker	5	5	1	1	1	1
B-capped chickadee	5	18	2	9	0	0
Downy woodpecker	3	3	1	1	0	0
Vesper sparrow	3	4	0	0	2	2
Northern flicker	3	3	1	1	0	0
Savannah sparrow	2	4	0	0	0	0
American kestrel	2	2	1	1	0	0
Tennessee warbler	2	2	0	0	1	1
Swamp sparrow	2	2	0	0	0	0
Spruce grouse	2	2	0	0	0	0
R. tail hawk	2	2	0	0	0	0
Merlin	1	1	0	0	0	0
Boreal chickadee	1	4	0	0	1	4
Marsh hawk	1	1	0	0	1	1
R-winged blackbird	1	1	0	0	1	1
Cedar waxwing	1	1	0	0	1	1
American redstart	1	1	0	0	1	1
R-breasted nuthatch	1	1	1	1	0	0
Trail's flycatcher	1	1	0	0	0	0
Horned lark	1	20	0	0	0	0
Canada goose	1	2	0	0	0	0
Snow bunting	1	15	0	0	0	0
Mallard	1	2	0	0	1	2
Green winged teal	1	2	0	0	1	2
Lesser yellowlegs	1	2	0	0	1	2
Great gray owl	1	1	0	0	0	0
Magpie	1	2	0	0	0	0
Magnolia warbler	1	1	0	0	1	1

Table 8b. Bird observations in younger stand.

Species	*Brushsaw* Observations	*Brushsaw* # Birds	*Release* Observations	*Release* # Birds	*Control* Observations	*Control* # Birds
Gray jay	1	1	0	0	4	7
Raven	0	0	1	1	1	1
Ruffed grouse	3	3	0	0	0	0
S. colored junco	1	4	0	0	0	0
Robin	0	0	2	2	1	1
W. throated sparrow	1	1	0	0	1	1
Least flycatcher	1	1	1	1	0	0
Hairy woodpecker	0	0	1	1	0	0
B-capped chickadee	0	0	1	1	1	4
Downy woodpecker	0	0	1	1	0	0
Vesper sparrow	0	0	0	0	1	2
Northern flicker	0	0	0	0	0	0
Savannah sparrow	0	0	4	4	0	0
American kestrel	0	0	0	0	1	1
Tennessee warbler	0	0	0	0	0	0
Swamp sparrow	0	0	0	0	0	0
Spruce grouse	0	0	0	0	0	0
R. tail hawk	0	0	0	0	0	0
Merlin	0	0	0	0	0	0
Boreal chickadee	0	0	0	0	0	0
Marsh hawk	0	0	0	0	0	0
R-winged blackbird	0	0	0	0	0	0
Cedar waxwing	0	0	0	0	0	0
American redstart	0	0	0	0	0	0
R-breasted nuthatch	0	0	0	0	0	0
Trail's flycatcher	0	0	0	0	0	0
Horned lark	0	0	0	0	0	0
Canada goose	0	0	0	0	0	0
Snow bunting	0	0	0	0	0	0
Mallard	0	0	0	0	0	0
Green winged teal	0	0	0	0	0	0
Lesser yellowlegs	0	0	0	0	0	0
Great gray owl	0	0	0	0	0	0
Magpie	0	0	0	0	0	0
Magnolia warbler	0	0	0	0	0	0

Table 8c. Bird observations in older stand.

Species	*Chainsaw* Observations	*Chainsaw* # Birds	*Release* Observations	*Release* # Birds	*Control* Observations	*Control* # Birds
Gray jay	3	4	2	5	2	2
Raven	1	1	1	1	1	1
Ruffed grouse	1	1	2	3	1	2
S. colored junco	2	16	0	0	0	0
Robin	1	1	0	0	1	1
W. throated sparrow	1	1	0	0	0	0
Least flycatcher	1	1	1	1	0	0
Hairy woodpecker	1	1	1	1	0	0
B-capped chickadee	0	0	1	1	1	4
Downy woodpecker	0	0	0	0	1	1
Vesper sparrow	0	0	0	0	0	0
Northern flicker	0	0	0	0	2	2
Savannah sparrow	0	0	0	0	0	0
American kestrel	0	0	0	0	0	0
Tennessee warbler	0	0	1	1	0	0
Swamp sparrow	1	1	1	1	0	0
Spruce grouse	1	1	0	0	1	1
R. tail hawk	0	0	0	0	0	0
Merlin	0	0	0	0	0	0
Boreal chickadee	0	0	0	0	0	0
Marsh hawk	0	0	0	0	0	0
R-winged blackbird	0	0	0	0	0	0
Cedar waxwing	0	0	0	0	0	0
American redstart	0	0	0	0	0	0
R-breasted nuthatch	0	0	0	0	0	0
Trail's flycatcher	0	0	0	0	0	0
Horned lark	0	0	0	0	0	0
Canada goose	0	0	0	0	0	0
Snow bunting	0	0	0	0	0	0
Mallard	0	0	0	0	0	0
Green winged teal	0	0	0	0	0	0
Lesser yellowlegs	0	0	0	0	0	0
Great gray owl	0	0	0	0	0	0
Magpie	0	0	0	0	0	0
Magnolia warbler	0	0	0	0	0	0

Figure 11. Number of bird species observed, by treatment.

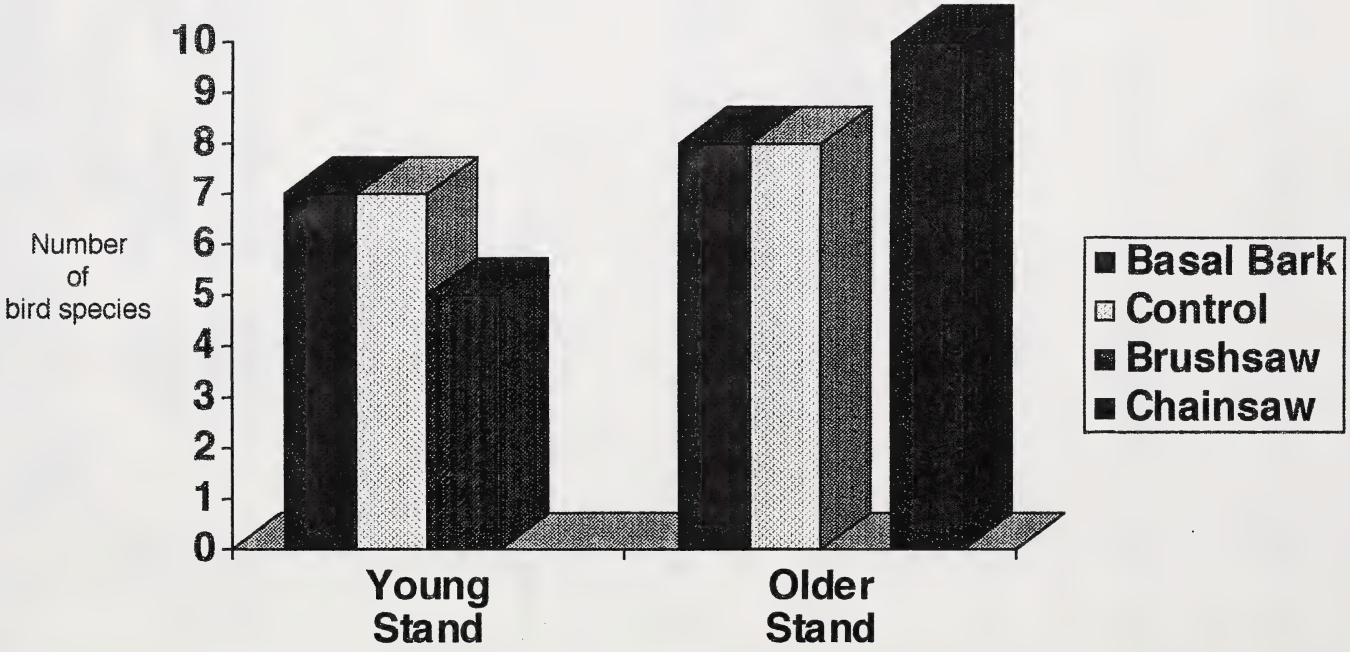


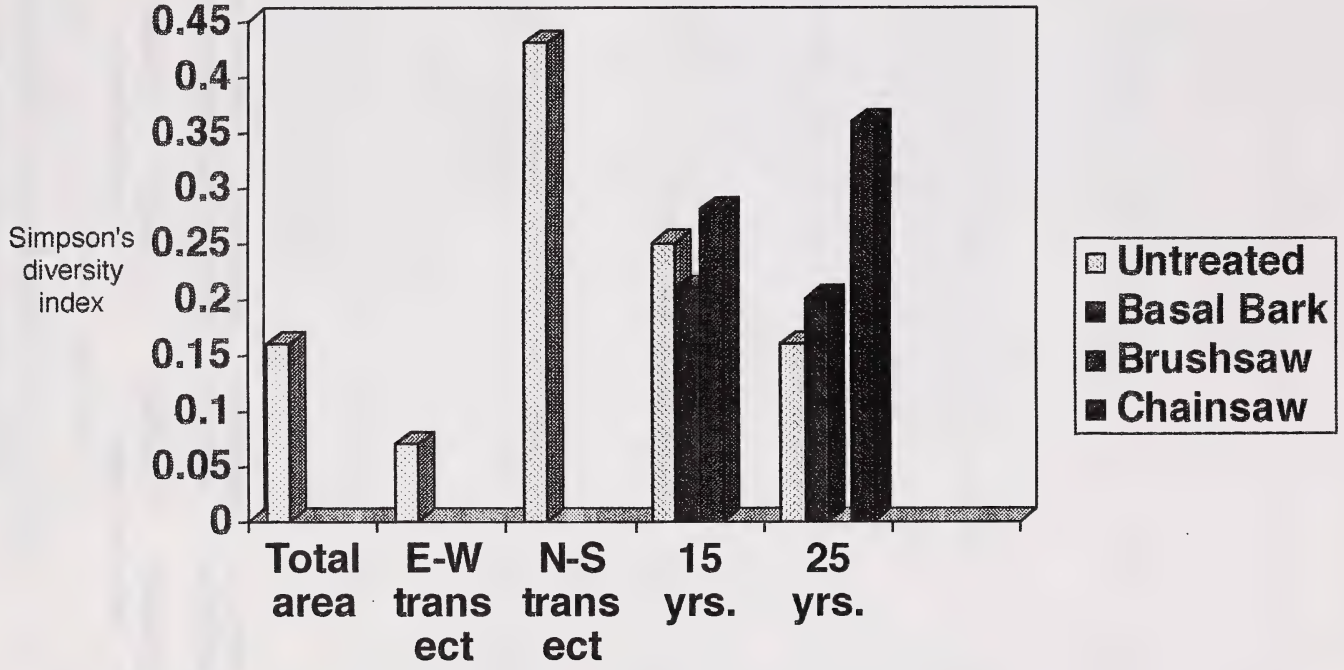
Table 9. Simpson's diversity index calculated for bird use of various treatments.

Species	Total area	N - S transect	E - W transect	Brushsaw	Young stand Release	Control	Chainsaw	Old stand Release	Control
Gray jay	33	19	2	1	0	7	4	5	2
Raven	22	7	2	0	1	1	1	1	1
Ruffed grouse	18	5	4	3	0	0	1	3	2
S. colored junco	114	89	5	4	0	0	16	0	0
Robin	9	2	2	0	2	1	1	0	1
W. throated sparrow	9	3	2	1	0	1	1	0	0
Least flycatcher	6	1	1	1	1	0	1	1	0
Hairy woodpecker	5	1	1	0	1	0	1	1	0
B-capped chickadee	18	9	0	0	1	4	0	1	4
Downy woodpecker	3	1	0	0	1	0	0	0	1
Vesper sparrow	4	0	2	0	0	2	0	0	0
Northern flicker	3	1	0	0	0	0	0	0	2
Savannah sparrow	4	0	0	0	4	0	0	0	0
American kestrel	2	1	0	0	0	1	0	0	0
Tennessee warbler	2	0	1	0	0	0	0	1	0
Swamp sparrow	2	0	0	0	0	0	1	1	0
Spruce grouse	2	0	0	0	0	0	1	0	1
R. tail hawk	2	0	0	0	0	0	0	0	0
Merlin	1	0	0	0	0	0	0	0	0
Boreal chickadee	4	0	4	0	0	0	0	0	0
Marsh hawk	1	0	1	0	0	0	0	0	0
R-winged blackbird	1	0	1	0	0	0	0	0	0
Cedar waxwing	1	0	1	0	0	0	0	0	0
American redstart	1	0	1	0	0	0	0	0	0
R-breasted nuthatch	1	1	0	0	0	0	0	0	0
Trail's flycatcher	1	0	0	0	0	0	0	0	0
Horned lark	20	0	0	0	0	0	0	0	0
Canada goose	2	0	0	0	0	0	0	0	0
Snow bunting	15	0	0	0	0	0	0	0	0
Mallard	2	0	2	0	0	0	0	0	0
Green winged teal	2	0	2	0	0	0	0	0	0
Lesser yellowlegs	2	0	2	0	0	0	0	0	0
Great gray owl	1	0	0	0	0	0	0	0	0
Magpie	2	0	0	0	0	0	0	0	0
Magnolia warbler	1	0	1	0	0	0	0	0	0
Totals	316	140	37	10	11	17	28	14	14
Simpson's Diversity	0.16	0.43	0.07	0.28	0.21	0.25	0.36	0.20	0.16

Table 10. Triclopyr residues in soil, following basal bark tending, 25 year old stand.

Sample timing	Sample description			
	In front of treated tree		*Behind treated tree*	
	Sample #1	Sample #2	Sample #1	Sample #2
June	Not detectable	Not detectable	0.16 ppm	0.26 ppm
October	Not detectable	Not detectable	Not detectable	0.35 ppm

Figure 12. Simpson's diversity index for bird use of various treatments.



Project costs

Direct Costs

Pretreatment tasks -	
proposal preparation, site selection, pre-treatment data gathering	$6087.00
Treatment tasks -	
Release® application, brushsaw and chainsaw tending	$17370.59
Post-treatment tasks -	
Bird surveys	$4240.00
Slash assessments	$1720.00
Soil analyses	$840.00
Total direct costs	$30257.59
minus Trust Fund contribution	$24960.00
balance paid by MDFP	***$5297.59***

Other in-kind financial support

Ace Vegetation Control Service Ltd.	
5 hours crew training	$1670.00
228 L Bayol 35, diluent for basal application @$2.15	$490.20
DowElanco Canada Inc.	
76.1 L Release® Silvicultural Herbicide @$25.00	$1902.50
Manning Diversified Forest Products	
3 days pretreatment assessments	$1200.00
3 days supervision of treatments	$1200.00
2 days slash assessments	$800.00
2 days post-treatment data gathering	$800.00
Total value (in-kind support)	***$8062.70***

Prepared by:
Incremental Forest Technologies Ltd.

References

Johnston, M. 1995. Does current forest management practice mimic the natural disturbance cycle? In: Managing Ontario's Mixedwoods. A Symposium, Forestry Canada Great Lakes Forestry Centre.

Rowe, J.S. 1972. Forest Regions of Canada. Department of Environment, Canadian Forestry Service.